

REMARKS

Reconsideration and allowance of the above application are respectfully requested.

As an initial matter, a newly executed COMBINED DECLARATION AND POWER OF ATTORNEY with the correct filing date for the provisional application is filed herewith to comply with the examiner's requirement.

With respect to the objection to the drawings in connection with the numeral "110" stated in the paragraph [0009] on page 3 of the specification, Applicant has amended this part of the specification to remove the numeral "110." This amendment conforms the text of the specification to the drawings and hence does not add new matter. Accordingly, this objection has been obviated by the amendment.

The Office Action objects to FIG. 1 in the drawings for using two numerals "101" and "120" to designate the mechanical scanning device. This, however, appears to be incorrect in part probably because the electronically filed drawings are too small. Attached is an enlarged copy of the originally filed drawing sheet with both FIGS. 1 and 2. Clearly, FIG. 1 as originally filed uses the numeral "101" and a lead line to designate "focusing optics" located between the scene 99 and the image sensor 100 while the numeral "120" is used for the mechanical scanning device. In addition, the text in the paragraph [0008] of the original specification unambiguously uses numerals "101" and "120" to respectively designate the focusing optics and the mechanical scanning device. This is consistent with the original FIG. 1. Hence, the objection to FIG. 1 should be withdrawn.

Applicant acknowledges that the original drawings are informal and for examination only. Formal drawings will be prepared and filed at a later time to correct all informalities in the original drawings.

The specification and abstract have been amended to correct typographical errors as indicated in the Office Action. No new matter is added.

Regarding the claims, Claim 14 has been amended to correct the informality indicated in the Office Action; Claim 18 has been amended to clarify its language and to include the features of Claim 19; Claim 19 has been canceled; and Claim 39 has been amended to clarify its language. In addition, Claims 40-51 have been newly added and are fully supported by the original specification.

Hence, upon entry of the above amendment, Claims 1-18 and 20-51 are pending. Claims 7-14, 20, 21, and 27-38 have been withdrawn from consideration by the Patent Office at this time.

We now turn to specific claim rejections.

Claim 39 stands rejected under 35 USC 112, first paragraph as allegedly being not described in the original specification. The Office Action specifically rejects the language of "electromagnetic energy" and "sensing the electromagnetic energy." This contention, however, is respectfully traversed.

Claim 39 is the original claim filed with the application and hence is part of the original specification. Therefore, "electromagnetic energy" is indeed described. Second, as well understood in this field, light or optical energy is an example within a selected spectral range of the "electromagnetic energy" and the understanding of the light in particular and the electromagnetic energy in general is well established and is extensively documented in the literature available to the public. Hence, there is no need to specifically describe

definitions and detection of "electromagnetic energy" in the application under the patent law. Thirdly, the original specification describes in its text and illustrates in its figures "sensing electromagnetic energy" by using a sensor array with an array of sensing pixels having photoreceptors. Hence, this recited feature in Claim 39 is fully described in a manner that complies with the requirements of 35 USC 112, first paragraph.

For at least these reasons, Claim 39 as originally filed is patentable under 35 USC 112, first paragraph. The rejection should be withdrawn.

Claims 1-6, 15-19, and 22-26 stand rejected under 35 USC 102(b) as allegedly being anticipated by Morokawa. Applicant respectfully traverses the rejections.

In general, the pending claims of this application recite systems and methods that move an input image relative to the sensing pixels during the image capture and to generate temporal signals that are encoded with spatial feature information of the input image. Such temporal information can be processed to extract the spatial features with a resolution pitch less than the pixel pitch of the sensing pixels. Morokawa, however, is completely silent on these and other features in the pending claims. Hence, the rejections are not supported by the disclosure of Morokawa and should be withdrawn.

More specifically, Claim 1 recites "a processing circuit, operating to produce pulsed outputs at timings that are dependent on changes of said image information" (emphasis added). First, this recited processing circuit produces "pulsed outputs." Morokawa reads out the average voltages accumulated in the pixels one frame at a time. Col. 3, lines 21-25 in cited in the Office Action describes scanned output by frame and storage in memory. Nothing in Morokawa describes such pulsed

outputs. For this reason alone, Claim 1 is patentable over Morokawa.

Secondly, Claim 1 recites the pulsed outputs are produced "at timings that are dependent on changes of said image information." As fully described in the specification, such timings are used to encode the spatial features of the input image scene into the temporal signal of the photoreceptor circuit so that the temporal signal can be processed to extract the spatial information of the image. Morokawa fails to disclose any aspect of such feature.

Notably, Claim 1 recites the timings of pulsed outputs are dependent on "changes of said image information." Hence, it is the change in the image information that triggers the pulsed outputs. In this manner, the spatial feature information in the image information is encoded in the timings of the pulsed outputs. By contrast, Morokawa read out occurs at specific locations in the vibration cycle and, therefore, is independent of the change in the image received by the image sensor. FIGS. 1, 2A-2D and 6B specifically illustrate this feature in Morokawa.

Hence, this distinction further supports that Morokawa fails to disclose each feature of Claim 1 and thus Claim 1 is patentable.

From yet another perspective, Morokawa uses the motion to capture multiple shots of the same input image to reduce the possibility of having any blank spots caused by dead pixels in the image sensor (FIGS. 1, 2A-2D). The multiple shots are taken at pre-set locations of the motion cycle for all input images and the signal readout is entirely independent of any aspect of the input image.

The system recited in Claim 1 is used to address an entirely different technical issue in imaging, i.e., the spatial

resolution. In most conventional image sensors, including the sensor by Morokawa, the spatial resolution is limited by the pixel pitch. One commonly known approach to higher resolution is to reduce the pixel pitch. Every CCD or other sensor manufacture has been trying everything to miniaturize line features in semiconductor processing, e.g., using UV light of shorter wavelengths during the photolithograph process.

Applicant of this application went beyond this conventional thinking and invented an entirely different approach to improving the imaging resolution. This approach, as fully described in the specification, uses the motion of an input image relative to the sensing pixels during the image capture and generates temporal signals encoded with spatial feature information of the input image. Such temporal information can be processed to extract the spatial features with a resolution pitch less than the pixel pitch of the sensing pixels.

In the originally filed application, Applicant used a vivid example to illustrate this innovative approach:

The resolution improvement can be understood by considering a visual scene with a thin line, for example a dark line over a light background. With a conventional visual sensor, if the thin line is thinner than the pixel spacing, then the image may partially or fully end up being between the photoreceptors. The thin dark line may therefore become undetected or undetectable. In contrast, the present application allows small scanning movements to be applied to the image, with a scanning movement having an amplitude at least equal to photoreceptor spacing. This means that at least one photoreceptor will cross the thin line at some point in time.

When this happens, the dark line may produce sharp transitions from light to dark and then dark to light at some point during the image sensor movement. These

transitions may be detected, and their timing may be used according to a digital processing signal, to locate the dark line. The location of the dark line is carried out at an effective resolution that may be higher than the pixel spacing.

See, paragraphs [0015] and [0016] of the original specification. Notably, the systems and techniques in the pending claims of this application make it possible to achieve improved imaging resolution based on any fabrication processes and can be used with future fabrication processes with finer feature dimensions. In addition to the improved resolution beyond the limit of the pixel pitch or spacing, Applicant also described processing methods to reduce the fixed pattern noise in image sensors due to differences in pixels.

Clearly, Morokawa does not address any of such issues associated with imaging resolution and fixed pattern noise. It should not be surprising that Morokawa does not teach resolution-enhancing features of Claim 1 and other pending claims of this application.

Based on the above reasons, Claim 1 is distinctly different from and is patentable over Morokawa.

Rejections to other claims based on Morokawa can be rebutted based on the above arguments for Claim 1. For example, Morokawa fails to disclose "processing said image information acquired by said first element, to obtain temporal information about said image information" as recited in Claim 15. Also, Morokawa fails to disclose "said processing circuit producing an output indicative of temporal fluctuations of information received by said photoreceptor element resulting from spatial features in said incoming scene moving over said photoreceptor circuit" recited in the amended Claim 18.

In addition, various rejections appear to be wrong on other grounds as well, such as misunderstanding of the present invention and the prior art.

For example, in rejecting Claim 4, the Office Action cites Morokawa, Col. 3, lines 60-61, which states that "the image sensor ... may be vibrated in two dimensions". This part of the Morokawa refers to two dimensions in the geometrical space, such as the x axis and the y axis. However, this has nothing to do with the "changes in said output signal which are either in positive directions or negative directions" in Claim 4 because this aspect of Claim 4 is about the direction of the change in the signal with respect to time.

As another example, the Office Action contends that Col. 4, lines 4-6 in Morokawa discloses the logarithmic amplifier in Claim 5. However, a review of this part of the Morokawa suggests that Morokawa describes various types of image sensors, none of which contains any logarithmic amplifier.

Hence, these rejections should be withdrawn for these reasons as well.

Finally, we respectfully submit that amended Claim 39 is patentable under 35 USC 102(b) over Hideshima because Hideshima, like Morokawa, fails to disclose "sensing the information about said electromagnetic energy that is independent of any fixed pattern noise in said array of photoreceptors by generating and processing temporal pulses from each photoreceptor caused by the movement to extract spatial features in said electromagnetic energy" as recited in amended Claim 39. Accordingly, this rejection should be withdrawn.

The newly added Claims 40-51 are patentable based on the above arguments as well as their own merits.

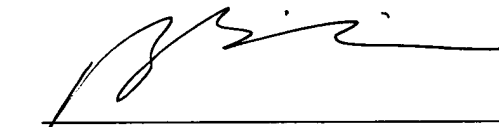
In view of the above, Applicant asks that all claims be allowed. Enclosed is a \$183 check for excess claim fees and a

\$55 check for the Petition for Extension of Time fee. Please
apply any other charges or credits to Deposit Account
No. 06-1050.

Respectfully submitted,

Date: _____

6-27-03



Scott C. Harris
Reg. No. 32,030

**/BY
BING AI
REG. NO. 43,312**

Fish & Richardson P.C.

Customer Number: 20985



4350 La Jolla Village Drive, Suite 500

San Diego, CA 92122

Telephone: (858) 678-5070

Facsimile: (858) 678-5099

10308066.doc